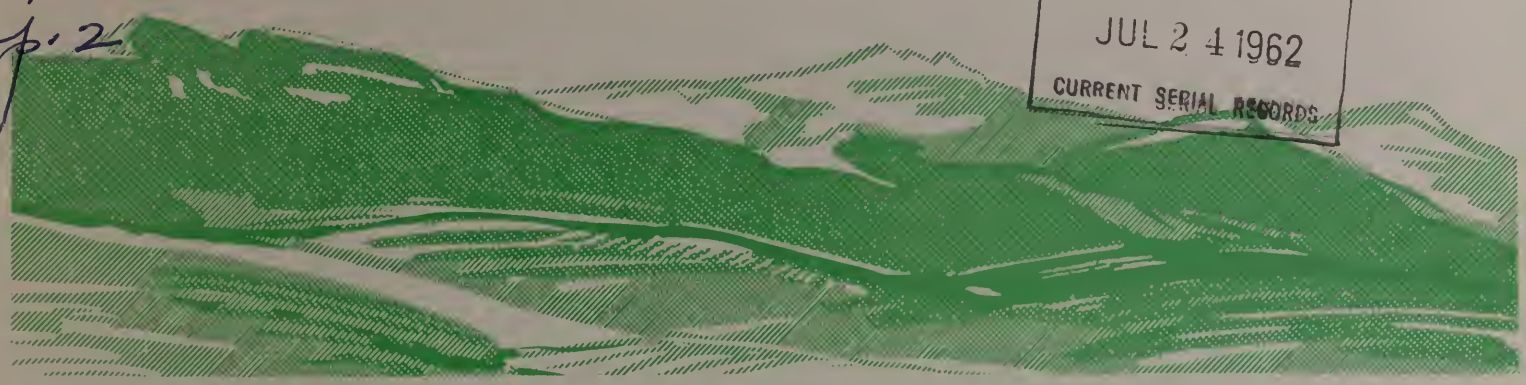


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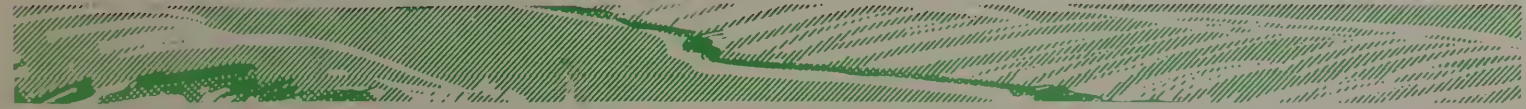
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RANGE IMPROVEMENT



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STATEMENT OF PURPOSE

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This publication is printed primarily to inform professional range administrators of important range improvement and management developments and findings. These "Notes" may include extracts of published papers, unpublished preliminary reports of research work, unpublished reports on administrative studies, and personal observations or suggestions of other range administrators. No claim is made as to the accuracy or completeness of studies or conclusions drawn.

All who read these RANGE IMPROVEMENT NOTES are encouraged to submit material for publication, or suggestions for improving its usefulness. Full credit will be given for any material used.

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REST-ROTATION GRAZING - A NEW MANAGEMENT SYSTEM FOR PERENNIAL BUNCHGRASS RANGES

By

A. L. Hormay^{1/} and M. W. Talbot^{2/}

- - -

Introduction

Through its forest and range experiment stations, the Forest Service has continually sought grazing methods that will improve the range and increase livestock and wildlife production.

A study carried out on the Burgess Spring Experimental Range in northeastern California during a 16-year period (1936-51), led to the design of a rest-rotation grazing system. This system holds great promise of improving and maintaining perennial bunchgrass range, the principal type of range in the West, and it may be applicable to any type of range.

It is now being tested on the Harvey Valley cattle allotment on the Lassen National Forest in northeastern California. The test was started in 1952 and is scheduled to run for 23 years. Results will be reported periodically as sufficient data are accumulated to allow proper evaluation. In the meantime, this publication has been prepared to describe the study on which rest-rotation grazing is based, and to present the design of the system for the benefit of those who wish to try it.

Description of Study Region

The region is mountainous and of volcanic origin. Interspersed among the mountains are many plains and valleys. The region is wet, cold and snowy in winter, and comparatively dry and warm in the summer.

Livestock summer ranges in this region are located mainly at altitudes above 4,000 feet. Unfortunately, forage production on many

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of these ranges has been reduced by grazing and other factors. Some are now producing half or less of their potential yield of forage and livestock.

On 97 percent of the range, forage is furnished primarily by bunchgrasses and other perennial plants that depend on seed for reproduction; on less than 3 percent, it is furnished by species that reproduce or spread vegetatively rather than from seed. The principal problems of grazing management in the region therefore center around the bunchgrasses.

Grassland, sagebrush, juniper, and pine types occupy 63 percent of the total area and furnish most of the forage use by the livestock.

Experimental Layout and Studies

The Burgess Spring Experimental Range is located in Lassen County approximately 40 miles northwest of Susanville. Cattle were grazed on three fenced units. One unit was on a representative area of cut-over pine type, and two were on a representative area of grassland type.

Data were collected on the character and growth of the vegetation, the response of the vegetation to both grazing and clipping, the weather, and the grazing habits and weight responses of the cattle for the main purpose of getting as clear a picture as possible of how bunchgrass ranges are affected by grazing.

The effect of cattle grazing on the vegetation was measured only in the timber type.

Livestock Grazing and Weight Records

For 3 years, 1936-38, records were made of the way cattle grazed the vegetation in the timber type. Selected, individual animals were followed on foot during daylight hours for 2 or 3 days each week, and records were made of the number of bites taken of the various plant species.

Weight gains of cattle were measured during eight grazing seasons in the timber type - 1936, 1937, 1938, and from 1944 through 1948 - and in five seasons in the grassland type - from 1944 through 1948.

Weather During the Study Period

Precipitation for a 12-month season averaged 18.06 inches during the 19-year period 1935-54. On the average, 74 percent of the total seasonal precipitation occurred during the 6 months from October 1 to April 1, mainly as snow. Twenty-one percent (3.82 inches) fell during the active growing season, April 1 through June. Only 5 percent fell during July, August, and September.

The lowest seasonal precipitation was 9.09 inches in 1939, and the highest 29.24 inches in 1938. Winter snowpack averaged about 1.5 feet deep, with a maximum pack of 6 feet in 1951.

Average daily air temperatures were below freezing from early December until mid-March, and up to 61° F. in July. The lowest temperature recorded was 27° in January 1937; the highest, 98° in July 1946.

Growth and Development of Vegetation

The average seasonal development of herbaceous vegetation in the timber type can be illustrated with Idaho fescue. Growth began about April 1 immediately after the winter snowpack melted, and ended about 120 days later in early August when seed ripened. This growth was sustained mainly by moisture accumulated in the soil up to the start of growth.

Flower stalks started to show above the basal leaves of the plants near the end of May. The plants grew rapidly during the next 4 weeks. They flowered and reached full height early in July. The plants dried rapidly during the first half of August. By October, both greenness and moisture content reached a minimum. Herbage production of the principal forage species in 1938, the best growth year, was estimated to be about three times greater than in 1939, the poorest year.

Some species produced seed more regularly from year to year than others. Western needlegrass and cheatgrass brome produced seed most consistently, followed in approximate order by bottlebrush squirreltail, mountain brome, Idaho fescue, Lemmon needlegrass, Sandberg bluegrass, longspur lupine, Ross sedge, antelope bitterbrush, and woolly wyethia. Drying of the soil early in the season, or freezing temperatures at flowering time, reduced or prevented seed formation in some species in some years.

Grassland Type

Vegetation development in the grassland type followed the same general trend as that in the timber type. Herbage production was estimated to be five or six times greater in good growth years than in poor ones. This variation is about twice as great as that in the timber type.

How the Vegetation was Grazed

In both the timber and grassland types, cattle grazed certain plant species and certain areas more consistently and more closely than others, resulting in very uneven utilization of the range. Though complex, the pattern of use was similar from season to season. Some species and some parts of the range were grazed closely and others lightly each season even under light or moderate stocking of the range as a whole.

Utilization in Timber Type

Practically every one of the 100 or more plant species in the timber type was grazed to some extent at one time or another during any given season. Twelve species supplied 95 percent of herbage taken by the cattle. Grasses supplied 61 percent, forbs 27 percent, and shrubs 12 percent.

Of the abundant species, six were grazed more consistently throughout the season than the others. These were Idaho fescue, bottlebrush squirreltail, mountain brome, woolly wyethia, longspur lupine, and antelope bitterbrush.

The degree of use of a species was affected by its abundance and distribution as well as by other factors.

Utilization was by no means uniform from plant to plant even in one species. For example, in 1947 about 43 percent of the herbage of Idaho fescue in timber openings was utilized by the end of the grazing season. At this time the remaining stubble and ungrazed growth averaged about 4 inches high. The average height of ungrazed plants was 17 inches. But averages do not tell the whole story. Forty percent of the stand was grazed to a 1-inch stubble, 29 percent to a 2-inch stubble, 13 percent to a 3-inch stubble, and 3 percent to a 4-inch or

taller stubble. Fifteen percent of the stand was not grazed at all. Some areas in the timber unit were consistently grazed closely, some moderately, and some lightly or not at all.

Utilization in Grassland Type

In the grassland type, as in the timber type, plant species and areas were selectively grazed. The principal species eaten were rushes, sedges, Nevada bluegrass, Sandberg bluegrass, aster, mat muhly, hairy California danthonia, bottlebrush squirreltail, and black sagebrush. Species that were eaten lightly, apparently because they were relatively unpalatable, included biscuitroot, plantainleaf buttercup, American bistort, and big sagebrush.

Effect of Clipping on Vegetation

Plants of Idaho fescue, bottlebrush squirreltail, woolly wyethia, and longspur lupine produced some regrowth after clipping at early growth stages and up until the time they reached the seed-in-milk stage. Virtually no regrowth was produced thereafter. The total combined weight of initial growth and regrowth increased with lateness of clipping. Clipping when the plants were growing actively reduced the total herbage yield during the season of clipping.

A single season of clipping materially reduced the basal area of the four species the next year. The basal area of Idaho fescue was reduced 49 percent, longspur lupine 59 percent, bottlebrush squirreltail 21 percent, and woolly wyethia 8 percent. In Idaho fescue, clipping when the plant was growing rapidly caused the greatest reduction in basal area. Even late in the season when the plants were dry and apparently dormant, clipping reduced basal area.

Four consecutive years of clipping at the seed-in-milk stage reduced basal area of Idaho fescue 80 percent, bottlebrush squirreltail 62 percent, longspur lupine 91 percent, and woolly wyethia 16 percent.

Clipping to a 1.5-inch stubble during the active growing season reduced the number and height of Idaho fescue flower stalks in the regrowth. The stunted flower stalks that were produced in the regrowth had little or no seed. Flower stalk production 1 year after clipping was severely reduced. Average reductions for 4 years ranged from 94 to 100 percent.

Defoliation at almost any time of the season is harmful to the plant, but it is especially harmful during rapid growth. At that time, stored foods are at a minimum; defoliation prevents further food storage. The present studies show that defoliation is harmful even after seed ripening when the plants are dry and apparently dormant.

Effect of Rest on Vegetation

Four years of rest after 4 years of continuous clipping at the seed-in-milk stage resulted in little or no recovery of original basal area of the four species studied. Apparently the soil space released by the clipped plants was encroached upon by adjoining unclipped plants, and this encroachment prevented material recovery of basal area of the clipped plants during the rest period.

Responses in flower-stalk production to resting were measured only in Idaho fescue. No flower stalks were produced during the first year of rest. Moderate to high production in comparison with unclipped plants was obtained in the second year, and full production in the third year. Apparently Idaho fescue will produce few if any flower stalks, and therefore little or no seed the first year after close grazing even though the plants are rested from grazing. Reasonably vigorous plants and adequate flower-stalk and seed production can be expected in the second season.

Effect of Grazing on Forage Production

Forage production in the timber type was reduced appreciably by eight seasons of grazing.

Loss in production resulted mainly from reduction of Idaho fescue in timber openings where grazing is normally concentrated on particular plants and areas. Use of Idaho fescue during the 8 years of grazing averaged only 32 percent. However, in 1946, after 8 years of use, grazed areas had 21 percent fewer Idaho fescue plants than comparable areas protected from grazing. Also, the plants on grazed areas were 42 percent smaller and produced 31 percent less herbage per unit of live basal area. These effects combined represent a 68 percent reduction in yield of Idaho fescue in open areas, or 21.4 pounds per acre. The total loss in yield of Idaho fescue and four other important forage species - bottlebrush

squirreltail, needlegrasses, longspur lupine and Ross sedge - was calculated at 25.9 pounds per acre which represents a loss of 8.2 percent of the grazing capacity of the entire unit.

Cattle Weights in Timber and Grassland Types

Each season from 1944 to 1948, one group of heifers was grazed in the timber type and a second comparable group in the grassland type. The average grazing season during the 5 years began May 23 and ended October 21. During this period, the heifers in the timber type gained 217 pounds per head; those in the grassland type, 227 pounds, or 10 pounds more.

In both types, the rate of animal gain changed continuously as the vegetation developed during the season. The relation between the weight trend of heifers grazed in the timber type and the growth and development of Idaho fescue was as follows: Daily weight gains of 1.14 pounds per head were made the first 2 weeks on the range when the vegetation was about 4 inches tall. By the time flower stalks on the plants were about half developed, rate of gain had increased to 1.93 pounds per day. A maximum rate of 2.29 pounds per day was reached just before flowering time in early July, but a gradual decrease followed until early October. Thereafter, weight losses occurred.

This trend bears out the general conclusions drawn by many investigators from chemical analyses and livestock digestion trials; the nutritive value of herbage is highest when the plants are green and growing rapidly.

The seasonal weight trends were similar in the timber and grassland types.

Conclusions From Studies

The present studies have reaffirmed previous observations that cattle prefer some plant species and range areas to others and graze them closely, which causes uneven utilization. The pattern of use is very complex, not only because of selective grazing, but also because the range is so variable. However, in spite of this, the pattern of use is much the same from year to year under the same management. The same plants and areas grazed closely one year tend to be grazed closely the next. Thus under continuous

seasonal grazing, some plants are repeatedly cropped closely and in time killed, and the production of the area is lowered. Range breakdown is spotty because of selective grazing and also because some sites deteriorate more rapidly than others under the same grazing pressure.

The basic problem in management is to change the grazing pattern so that palatable forage species can be maintained on the most heavily grazed range area. It is evident that selective grazing cannot be prevented by adjusting the stocking rate, because even under light stocking some plants are closely grazed. Nor is it possible to graze the range at a season that would not be harmful to the vegetation without foregoing use of the vegetation when it has highest grazing value. And, of course, selective grazing cannot be avoided by any practical livestock distribution measure.

Although little if anything can be done to prevent selective grazing while the range is grazed, the harmful effects of selective grazing can be counteracted by resting the range from grazing at appropriate intervals so that all plant species - those usually heavily grazed as well as all others - have an opportunity to grow and reproduce normally. The rest-rotation grazing system was therefore designed to make this possible and thereby increase forage and livestock production.

Design and Application of Rest-Rotation Grazing

Improvement of ranges depends on restoration of vigor of desirable forage species and establishment of new plants from these species. Under rest-rotation grazing heavy emphasis is placed on restoration of vigor to the point where seed can be produced and where conditions are systematically created for establishment of seedlings of desirable forage plants. The general form of rest-rotation grazing, therefore, consists of four basic steps in the following sequence:

<u>Step</u>	<u>Symbol</u>
1. ---- Graze the range for maximum livestock production ---	GL
2. ---- Rest the range until plant vigor is restored -----	RV
3. ---- Rest the range until seed ripens, then graze for maximum livestock production -----	RS
4. ---- Rest the range until reproduction becomes firmly established -----	RR

The number of years required to apply these steps depends on the growth requirements of the key species on the range, the one species most desired for forage and plant cover.

The first step (grazing) is usually one season long. The second may take one or more seasons, or may be less than a full season, depending on how much time it takes to restore vigor of the key species on the particular range. The third step, which calls for resting the range until seed ripens and then grazing the remainder of the season, takes one full season. Provision for this third step is exceedingly important not only because it insures seed, but also because the trampling associated with grazing after seed-fall is needed to get as much seed as possible worked into the soil. The fourth step which makes sure that seedlings are well established, may take 1, 2, or even 3 years to complete, again depending on the requirements of the key species and the condition of the range, particularly the soil.

Thus the four basic steps may take 4, 5, 6, or more years to apply. The practice or practices applied in one year comprise a yearly treatment. To illustrate, a range requiring one season of rest for restoration of plant vigor and two seasons of rest for establishment of reproduction would require five yearly treatments:

<u>Year</u>	<u>Treatment</u>	<u>Symbol</u>
1st ---	Graze the range for maximum livestock production ---	GL
2d ---	Rest the range until plant vigor is restored -----	RV
3d ---	Rest the range until seed ripens, then graze for maximum livestock production -----	RS
4th --	Rest for establishment of reproduction -----	RR
5th --	Continue rest for establishment of reproduction -----	RR

Completion of the yearly treatments culminating in establishment of reproduction constitutes a grazing cycle. The cycle is repeated over and over until the range is restored to satisfactory condition. Then, the range may be rested less and grazed more to make fuller use of the vegetation and produce more livestock.

To apply this system, the range has to be divided into the same number of units as the number of treatments used. The units should be about equal in grazing capacity. In any given year each unit

receives a different yearly treatment, so some units are rested while others are grazed. Thus, the distribution of treatments among units during a grazing cycle for the five-unit plan described above, for example, is as follows:

<u>Year</u>	<u>Treatments</u>				
	<u>Unit 1</u>	<u>Unit 2</u>	<u>Unit 3</u>	<u>Unit 4</u>	<u>Unit 5</u>
1st -----	GL	RV	RS	RR	RR
2d -----	RV	RS	RR	RR	GL
3d -----	RS	RR	RR	GL	RV
4th -----	RR	RR	GL	RV	RS
5th -----	RR	GL	RV	RS	RR

In this case all the livestock grazed on the range in a particular year are placed in the unit receiving treatment GL at the beginning of the grazing season. Then after seed ripens they are moved to the unit receiving treatment RS and left there the remainder of the season. The unit receiving treatment RV and the two receiving RR are not grazed.

A table like this can be set up for grazing plans involving any number of yearly treatments. Notice the regular pattern of the plan; treatments run from the first to the last in order down column one and across the first line (1st year). The remainder of the treatments in the body of the plan follow in regular order. Treatments are properly allocated to unit when the same treatment symbol appears in a diagonal line from lower left to upper right.

The rate at which a range improves when given proper rest depends on the condition of the range and the weather. Ranges in poor condition will respond slowly and produce rather low yields of forage and livestock. Ranges in fair to good condition can be expected to improve more rapidly and produce more nearly normal yields. Although the number of treatments needed for good results will vary from range to range, a five-treatment plan will probably satisfy the requirements of most bunchgrass ranges in the West.

Stocking

Under rest-rotation grazing, stocking is based on the production and use of herbage from all the available forage species and not on the key species alone.

Stocking resulting in satisfactory range condition and livestock production cannot be determined accurately prior to actual experience on the range. However, it can be estimated from forage production, or on the basis of actual use elsewhere on a similar type range. After stocking is set on this basis, it can be adjusted upward or downward depending on the responses observed in the range and livestock.

Fairly heavy stocking is desirable in rest-rotation grazing. It forces greater use of the less palatable forage species and the less accessible grazing areas, and this results in intensive trampling in places where reproduction is most needed.

Season of Grazing

The clipping studies showed that seasonal herbage yield is reduced by defoliation during the growing season when the vegetation is growing and green. On the other hand, cattle made greatest weight gains during this period. The grazing season yielding maximum livestock production under any given stocking, therefore, is the one that strikes the optimum balance between herbage yield and nutritive value.

To provide a general guide for selecting a suitable grazing season, the yield of forage and livestock for various length grazing seasons was calculated from data obtained at Burgess Spring on plant growth and development, effect of clipping on herbage yield and rate of livestock weight gains during the season. The results of these calculations are shown in the following tables.

The figures for the different seasons are all related to plant growth and development and thus to one another. The absolute values are significant only at Burgess Spring. The relationship between seasons can be used elsewhere on similar ranges when interpreted in terms of plant growth stages rather than calendar date.

TABLE I - Estimated forage and cattle production from various grazing seasons and stocking rates for 66-percent forage use, 1/ pine timber type, the Burgess Spring Experimental Range

Length of seasons in months	Beginning of grazing season and average growth stage of vegetation	End of season	Cattle per section	Weight gain per animal	Cattle production per acre	Forage production per acre
1	June 21. Flower stalks two-thirds grown	July 20	246	71	27.3	242
2	June 11. Flower stalks one-third grown	Aug. 9	123	130	25	241
3	June 1. Flower stalks emerging from boot	Aug. 29	79	177	21.8	213
4	May 22. Flower stalks in midboot	Sept. 18	58	212	19.2	228
5	May 12. Flower stalks low in boot	Oct. 8	44	227	15.6	216

1/ In terms of Idaho fescue.

TABLE II - Estimated forage and cattle production from various 4-month grazing seasons and stocking rates for 66-percent forage use, 1/ pine timber type, the Burgess Spring Experimental Range (Contd.)

Beginning of grazing season and average growth stage of vegetation ^{1/}	End of season	Cattle per section	Weight gain per animal	Cattle production per acre	Forage production per acre
April 22. Leaves about 2 inches tall	Aug. 19	<u>No.</u> 48	<u>Pounds</u> 201	<u>Pounds</u> 15.1	<u>Pounds</u> 185
May 2. Leaves about 3 inches tall	Aug. 29	51	212	16.9	203
May 12. Flower stalks low in boot	Sept. 8	55	216	18.6	217
May 22. Flower stalks in midboot	Sept. 18	58	212	19.2	228
June 1. Flower stalks emerging from boot	Sept. 28	59	198	18.3	234
June 11. Flower stalks one-third grown	Oct. 8	60	178	16.7	236
June 21. Flower stalks two-thirds grown	Oct. 18	60	152	14.3	237

^{1/} Utilization assumed measured on October 18 for all seasons in terms of Idaho fescue..

The grazing season best suited to a particular situation is determined not only by the livestock-producing potentialities of the season but by other considerations, such as the time the particular range is needed in the ranching operation as a whole and the condition and weight gains desired in the livestock. For example, the longest practical grazing season in the Burgess Spring locality is about 5 months, starting May 12 when flower stalks of Idaho fescue are in low boot, and ending October 8 when cattle start losing weight. This season would produce 227 pounds gain per animal or 15.6 pounds gain per acre. A 4-month grazing season starting on May 22 when the flower stalks of Idaho fescue are in midboot would produce only 212 pounds gain per animal but 19.2 pounds per acre. Thus, although the seasonal weight gain of the average animal is 7 percent less under the 4-month season than under the 5-month season, livestock production per acre is 23 percent greater. Since rest-rotation grazing allows range maintenance regardless of the time of beginning and ending of the grazing season, the choice of seasons is up to the livestock operator.

Livestock Distribution

The need for subdividing the range into units and restricting animals to a part of the range under rest-rotation grazing generally results in better livestock distribution and more complete use of the available forage. However, there may still be a need for additional control of animal distribution with water developments, judicious placement of salt, and riding or herding.

How to Judge Effectiveness of Management

The establishment of new seedlings of desirable forage species is often the most important single criterion that can be used to judge whether a rest-rotation grazing system is improving the range. Numerous 2- and 3-year-old seedlings in the spaces between vigorous older plants indicate that parent plants are producing abundant viable seed, and that forage cover is thickening and grazing capacity increasing. The place to look for new seedlings is on closely grazed areas. If seedlings are becoming established here, then they are probably becoming established on less heavily grazed areas also.

In effect, grazing is eliminated as an environmental factor under rest-rotation grazing. During rest periods, plants that are usually

heavily grazed as well as all others are given an opportunity to develop full vigor and compete freely with each other. The species best adapted to prevailing site conditions regenerate first and become dominant, and as the site improves, other species become established in normal successional patterns. Fortunately, desirable forage species increase, and undesirable ones decrease under these conditions on most ranges.

Invaluable information on the adequacy of grazing management is provided by reliable records of animal weight gains, condition, mortality by causes, and calf crop. Much of this information can be obtained by observation. However, the only satisfactory way of getting weight information is to weigh the animals.

Abstract from PRODUCTION RESEARCH REPORT No. 51,
U. S. Dept. of Agriculture, Forest Service - October 1961.

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You can tell when you are on the right grade -

It's upgrade.

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The simplest way to better your lot is to
do a lot better.

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A LET-DOWN FENCE TOOL

By Daniel S. Good - Laborer III, Manti-LaSal N. F.

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Many fences used for management of the national forests are of the let-down type. These must be dropped in the fall of the year to protect them from being broken by snow pack. They must be put back up each spring to serve the purpose for which they were built. To get this done properly a lot of pulling and tugging is necessary. This suggestion is for a tool that will simplify putting these fences up and taking them down.

The tool is made from a piece of hardwood 1"x1-1/2"x30", to which is attached about five feet of halter chain or any light weight chain, and two hooks. One hook is on each end of the chain, and one end of the chain is bolted to the hardwood handle.

This works on the same principle as a "farmer gate" but is adjustable so it can be used on a small post or a large tree or anything in between. It is also portable where the pry stick on a "farmer gate" is attached to the gate post.

